allow continuous delivery of the diluted gas for analysis by appropriate equipment provided at an analysis bench (not shown). A diluted sample pressure gauge **259** is fitted to the first analysis line **254**.

Connected to the first analysis line **254** at a junction **260** is a second analysis line **262** which connects the line **254** to a mass flow controller **264** via the junction **260**. The mass flow controller **264** receives the diluted sample (under pressure) and meters the gas allowed to pass therethrough in response to the predetermined control signals **266**. Selective operation of the mass flow controller **264** is dictated by a measuring device **265** that outputs a control signal **266** to the controller **264** through a communication line **268** (shown in broken lines). A conduit **270** allows for distribution of the diluted sample to a plurality of sample collection bags **272**, **274**, **276**, **278** through a like number of collection bag connecting lines **280**, **282**, **284**, **286**. A greater or lesser number of collection bags may be used. The bags **272**, **274**, **276**, **278** are provided to allow the operator the option of collecting samples for later analysis. A series of solenoid valves **288**, **290**, **292**, **294** are respectively fitted to the connecting lines **280**, **282**, **284**, **286**. The valves provide the operator with the ability to selectively close and open individual lines.

The line **254**, the back pressure regulator **256**, and the output line define an instantaneous analysis line, generally identified as **296**. The second analysis line **262**, the mass flow controller **264**, the conduit **270**, the collection bags **272**, **274**, **276**, **278**, and the lines **280**, **282**, **284**, **286** define a bag collection line, generally identified as **298**.

The analysis system **250** allows for continuous analysis of the diluted samples through operation of the instantaneous analysis line **288**. The undiluted pollutant concentrations are first obtained by multiplying the diluted concentration by the dilution ratio. (As noted above, in practice, the dilution ratio is determined by analyzing the undiluted calibration gas and dividing that concentration by the concentration of the diluted calibration gas produced by the diluter as determined by the analyzer system.) The instantaneous exhaust concentration can then be multiplied by the corresponding exhaust mass flow rate to obtain the instantaneous mass flow rate of the pollutant. By integrating this mass flow rate over time, the total mass of pollutants produced during a test cycle can be obtained.

Alternately, by operation of the bag collection line **290**, a sample of the diluted exhaust can be collected in the sample collection bags **272**, **274**, **276**, **278** by metering a small amount of the diluted exhaust at a flow rate proportional to the exhaust flow rate using the mass flow controller **264** in response to control signals **266**. Provided the control signals **266** are directly proportional to the exhaust gas flow rate, the total mass of pollutants can then be obtained by analysis of the sample collection bags **272**, **274**, **276**, **278** and multiplying the concentration by the dilution ratio and the total exhaust volume. (The instantaneous exhaust flow rate and total exhaust volume can be determined by using existing techniques such as dilution air flow metering with the CVS.)

The arrangements of the present invention provide reliable, controllable, and accurate sample-diluent ratio control. In addition, the various diluter systems described above are effective within a wide range of exhaust pressures. Tests conducted have demonstrated that the exhaust pressure may be quickly varied from near-atmospheric to about 10 p.s.i.g., and back to atmospheric pressure with the dilution ratio being accurately maintained.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the present invention can be implemented in a variety of forms. Therefore, while this invention has been described in connection with particular examples thereof, the true scope of the invention should not be so limited since other modifications will become apparent to the skilled practitioner upon a study of the drawings, specification and following claims.

What is claimed is:

1. An apparatus for controlling the dilution of an exhaust gas sample from the exhaust system of an engine for analysis, the apparatus comprising:

an exhaust gas sampling line through which passes a quantity of the exhaust gas sample, said exhaust gas sampling line having an orifice;

a source of substantially pollutant-free diluent gas;

a diluent line connected to said source of diluent gas, said diluent line having an orifice;

a diluent pressure regulator fitted to said diluent line and connected to said exhaust gas sampling line for controlling pressure such that said exhaust gas sampling line orifice and said diluent line orifice produce substantially equal pressure drops thereacross;

a diluent portion connected to said exhaust gas sampling line and said diluent line for diluting the exhaust gas sample with a quantity of said substantially pollutant-free diluent gas to create a diluted exhaust gas sample;

a delivery portion for delivering said diluted exhaust gas sample to an exhaust emission analyzer; and

a system for directing said diluted exhaust gas sample to said exhaust emission analyzer at a flow rate sufficient for analysis.

2. The apparatus of claim **1**, wherein said system includes a pressure regulator to allow continuous analyzing of said diluted exhaust gas sample.

3. The apparatus of claim **1**, wherein said system includes at least one sample bag and means for metering the flow of said diluted exhaust gas sample to said at least one sample bag in proportion to the flow of said diluted exhaust gas sample.

4. The apparatus of claim **3**, wherein said means for metering the flow to said at least one sample bag comprises a mass flow controller.

5. A method for preparing a diluted sample of exhaust gas from the exhaust system of an engine for analysis, said method including the steps of:

extracting an exhaust gas sample from the exhaust system of an engine and passing said exhaust gas sample through an exhaust gas sampling line having an orifice;

extracting a diluent gas from a diluent gas source and passing said diluent gas through a diluent line having an orifice;

fitting a pressure regulator to said diluent line and in connection with said exhaust gas sampling line;

controlling pressure such that said exhaust gas sampling line orifice produce substantially equal pressure drops thereacross, to maintain a substantially constant volumetric ratio of said exhaust gas sample and said diluent gas;

introducing said diluent gas into said exhaust gas sample to create a diluted exhaust gas sample;

establishing a dilution ratio between said diluent gas and said exhaust gas sample;

directing said diluted exhaust gas sample to an exhaust emission analyzer at a flow rate sufficient for analysis; and

analyzing said diluted exhaust gas sample.